

Lightweight High Temperature Non-Eroding Throat Materials for Propulsion Systems, Phase II

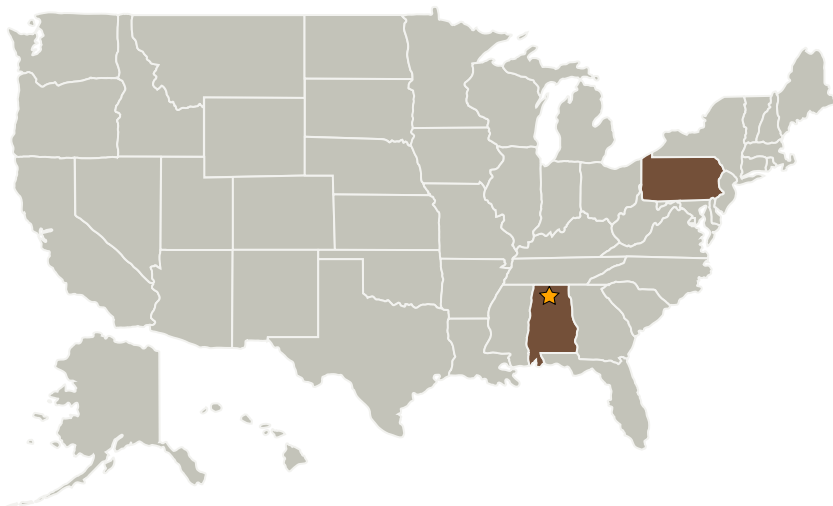
Completed Technology Project (2007 - 2009)



Project Introduction

Radiation or passively cooled thrust chambers are used for a variety of chemical propulsion functions including apogee insertion, reaction control for launch vehicles, and primary propulsion for planetary spacecraft. The performance of these thrust chambers is limited by the operating temperature and thermal-chemical response of the available materials. The Phase I efforts focused on performing design and analysis services to address multiple areas related to the development of lightweight high temperature non-eroding materials for liquid propulsion combustion chambers. We showed through theoretical thermal-structural calculations that monolithic HfO₂ and ZrO₂ are the best performing ceramic thermal barriers for Ir/Re combustion chambers within liquid engines. In the Phase II effort, MR&D proposes to use the lessons learned from the Phase I studies to evaluate material options, optimize the design, demonstrate scale up to and fabrication of a full scale combustion chamber for the NASA 3000-5000 lb LOX/CH₄ engine, and ultimately hot-fire the chamber at NASA. This will be in direct support of NASA MSFC Lunar Lander Ascent Stage engine. The Phase II tasks include: 1) Detailed thermal-structural design and analyses; 2) Addressing fabrication stresses/strains; 3) Addressing vibration stresses/strains; 4) Performing material characterization; 5) Performing any design revisions based on the material property characterization as it becomes available; 6) Fabrication of a full scale combustion chamber that reflects the best performing materials and geometry resulting from the thermal-structural design studies; 7) Performing pretest predictions and assisting with instrumentation for the hot-fire test; and 8) Performing posttest data correlation and suggesting design improvements.

Primary U.S. Work Locations and Key Partners



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★ Marshall Space Flight Center(MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
Materials Research and Design, Inc.	Supporting Organization	Industry	Wayne, Pennsylvania

Primary U.S. Work Locations

Alabama	Pennsylvania
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Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX01 Propulsion Systems
 - └ TX01.1 Chemical Space Propulsion
 - └ TX01.1.3 Cryogenic